Space Weather Technical Forecast

Issued on Thursday, 12 October 2023 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Chance of G1/Minor Geomagnetic Storm intervals day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low activity was observed, with only C-class flares observed, the largest of which was a C7.2 at 11/0937 UTC. There are currently nine sunspots on the visible disc. AR3451 has reached the western limb and is now difficult to analyse due to the foreshortening effect, and therefore maintains it's previous classification. AR3460 has simplified, losing its delta spot. AR3465 is currently thought to be the largest region, though appears largely stable at present. All other spots are small and simple.

Solar Wind / Geomagnetic Activity: Solar winds as observed at L1 by ACE/DSCOVR have persisted at generally slow-ambient conditions. The solar wind speed was relatively stable, around 300 km/s. Density was below average. Total interplanetary magnetic field (IMF) strength, Bt, was weak throughout. The north-south component, Bz, was weak and variable, ranging from -4/+4 nT. Phi angle was predominately positive (away from the Sun) until 11/1500 UTC when it became negative (Toward the sun). Geomagnetic activity has been Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was Background to Moderate. Associated 24-hour fluence was below the Active (1e8 integrated pfu) threshold. The observation at 12/0000 UTC was 3.88e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is likely with a chance of increasing to Moderate with isolated M-flares. The risk may then reduce from 13 Oct as AR3451 departs the disc.

Solar Wind / Geomagnetic Activity: A CME associated with the C6.6 flare of AR3460 that left the Sun on 08 Oct may arrive at Earth early day 1 (12 Oct). No further Earth-directed CMEs have been observed. Solar winds are expected to remain slow until Earth moves into the fast wind from CH58/- from early on day 1 (12 Oct), peaking at slightly elevated or elevated levels of 450-550 km/s and lasting until day 2 (13 Oct). Later on day 2 (13 Oct) winds are anticipated to gradually ease back toward background.

Quiet (Kp 0-2) geomagnetic activity is expected initially, this increasing to largely Unsettled to Active (Kp 3-4) through day 1 before easing into day 2, with a chance of G1/Minor storm periods due to combined coronal hole high speed stream and CME impact. Activity easing to mainly Quiet to Unsettled (Kp 0-2) later on Day 2 (13 Oct), with no further enhancements currently expected.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux will most likely remain at background levels. High energy electron flux (greater than 2MeV) is forecast to remain largely at background to moderate levels, dropping out with any fast wind or CME arrivals before potentially increasing from 13 Oct. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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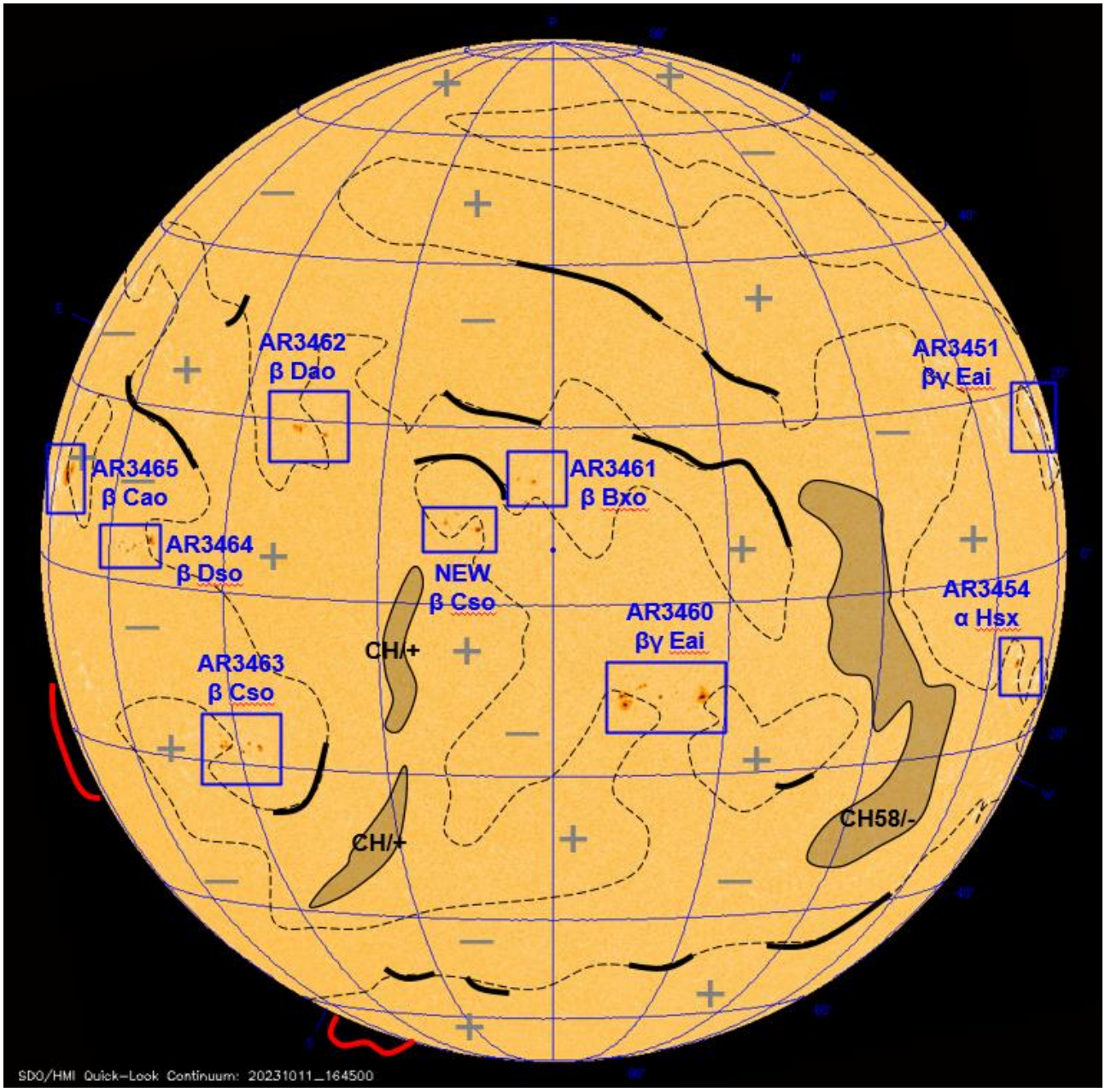
Figure 1. Solar Analysis Valid 11/1700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME associated with the C6.6 flare of AR3460 that left the Sun on 08/0339 UTC, may arrive at Earth early day 1 (12 Oct). No further Earth-directed CMEs have been observed.

Slow wind conditions initially. Earth is likely to move into the fast wind from CH58/- from early on day 1 (12 Oct), peaking at slightly elevated or elevated levels of 450-550 km/s and lasting until day 2 (13 Oct). Evidence suggests ENLIL was too quick with timings and speeds of high speed streams, though SWPM is perhaps closer to the expected speeds of CH58/-. Later on day 2 (13 Oct) winds are anticipated to gradually ease back toward background.

Quiet (Kp 0-2) geomagnetic activity is expected initially, this increasing to largely Unsettled to Active (Kp 3-4) through day 1 before easing into day 2, with a chance of G1/Minor storm periods due to combined coronal hole high speed stream and CME impact. Activity easing to mainly Quiet to Unsettled (Kp 0-2) later on Day 2 (13 Oct), with no further enhancements currently expected.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
08/1435	Partial	AR3460	SE	460 km/s	Early 12 Oct	Low confidence, dependent on fast wind interactions.

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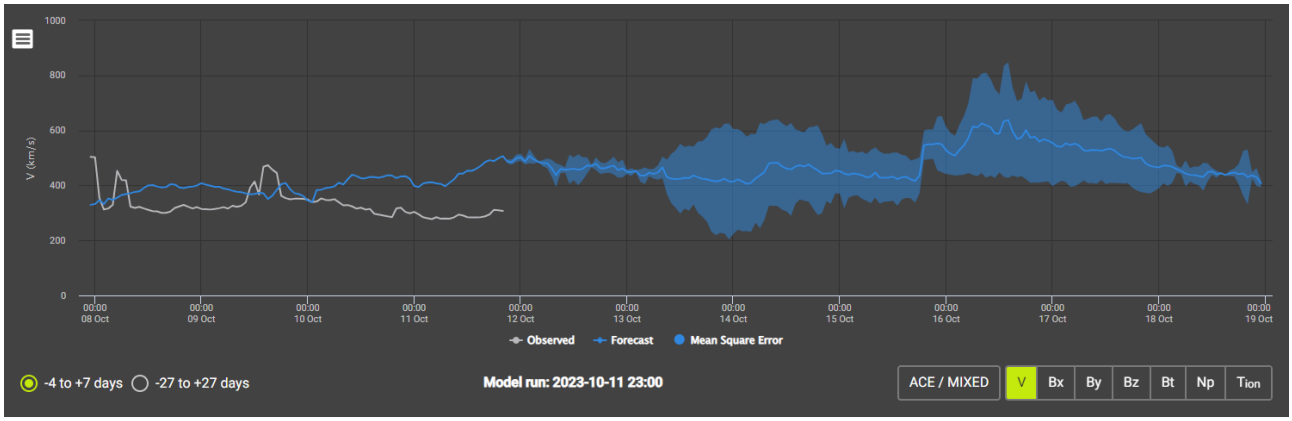
Figure 2: SWPM



Radio Blackouts - X-Ray Flares:

There are currently nine sunspots on the visible disc. AR3451 has reached the western limb and is now difficult to analyse due to the foreshortening effect, and therefore maintains it's previous classification. AR3460 has simplified, losing its delta spot. AR3465 is currently thought to be the largest region, though appears largely stable at present. All other spots are small and simple.

Low activity was observed during the last 24 hours, with only C-class flares observed, the largest of which was a C7.2 at 11/0937 UTC. Low to Moderate activity is expected, with a chance of further isolated M-flares..
Solar Activity is forecast to be Low to Moderate with an ongoing chance of isolated M-class flares. The risk is expected to reduce slightly from Day (13 Oct) as AR3451 moves around the northwest limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

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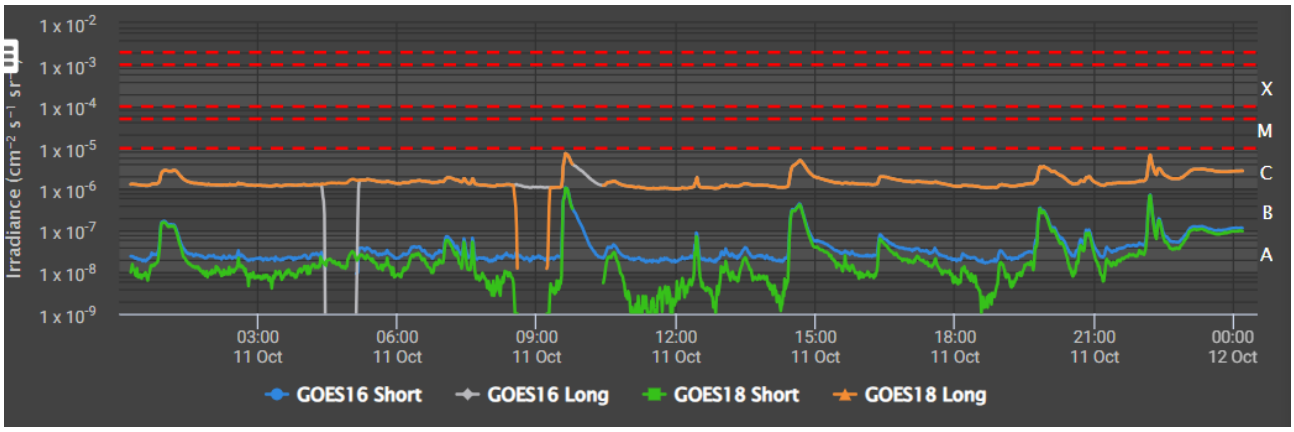
Figure 3: 24 hour xray trace



Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at background levels. There remains a very slight chance of S1/Minor Solar Radiation Storms throughout the period, should any larger flares occur.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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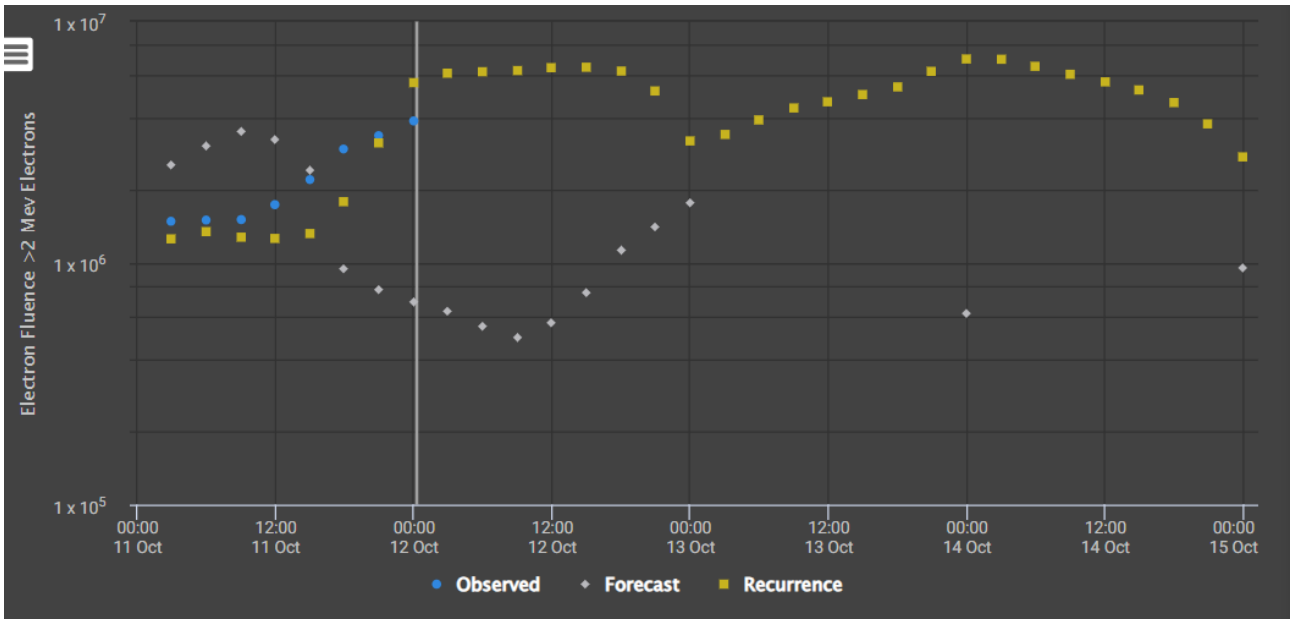
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 has peaked at moderate levels at the diurnal maximum in recent days, but is expected to continue at mainly background levels. Any fast wind arrival from CH58/- may act to initially supress observed values, alongside the potential CME arrival early 12 Oct, but will see an increase in electron flux through the Van Allen Belts at lower orbits. This may lead to the observed flux at GEO increasing as solar wind pressure eases, bringing a chance of Moderate levels from 13 Oct.

Electron fluence is forecast to be well below the Active (1e8 integrated pfu) level throughout, however, albeit with a slight increased trend from 13 Oct. MOSWOC REFM output is currently considered to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	20	20	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM



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